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ABSTRACT

Early experiments with the ATS-1 and ATS-3 satellites utilized one way and two way audio for a variety of university purposes, and several different television modes were employed in the ATS-6 satellite. Among the higher education activities on ATS-6 were inservice teacher education and the facilitation of regionalized medical education. A college curriculum sharing experiment between Stanford and Carleton Universities is to be carried out on CTS. Previous efforts to implement computer aided instruction via satellite have run into technical or other difficulties, and future efforts in this area need to be planned carefully and supported adequately. There is a much firmer base of experience with audio and video. Higher education involvement in satellite activity thus far has been focused primarily on inservice or continuing professional education, and on medical education. Areas which seem promising for the future include bringing "open university" or "external degree" services to remote areas, and the sharing of curricula, video programing, library and computer based programing and resources among geographically dispersed institutions. Organizational and economic, as well as technical, factors need careful consideration. Included with this paper is an annotated bibliography of selected documents. (Author/WBC)

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"APPLICATIONS OF COMMUNICATIONS SATELLITES IN HIGHER EDUCATION"

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APPLICATIONS OF COMMUNICATIONS SATELLITES IN HIGHER EDUCATION

by

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ABSTRACT

This paper has been prepared to provide information and ideas to groups with interest in using communications satellites in higher education. Educational telecommunications services which might be delivered via satellite include television, radio (audio), computer-assisted instruction, computer resource sharing, library and information resource sharing, teleconferencing, and the electronic blackboard.

Early experiments with the ATS-1 and ATS-3 satellites utilized one-way and two-way audio for a variety of university purposes in the Pacific region and for in-service teacher education in Alaska. Several different television modes, including one-way video with audio feedback, two-way video, still-picture television and teleconferencing were employed in the ATS-6 satellite Health/Education Telecommunications Demonstration and/or will be used on the CTS satellite. Among the higher education activities on ATS-6 were in-service teacher education in Appalachia and the facilitation of regionalized medical education in the northwest and Alaska through the WAMI experiment. A college curriculum sharing experiment using two-way video is to be carried out in engineering between Stanford University and Carleton University (Ottawa) on CTS.

A variety of uses for audio and video have been or will be demonstrated in these experiments. Relatively little emphasis has been placed to date on satellite delivery of computer-aided instruction, computer resource sharing, or library and information resource sharing, activities which all could potentially be useful in higher education. Previous efforts to implement computer-aided instruction via satellite have run into technical or other difficulties which indicates that future efforts in this area, if deemed desirable by users, need to be planned carefully and supported adequately. There is a much firmer base of experience with audio and video.

Higher education's involvement in satellite activity has been focussed primarily on in-service or continuing professional education and on medical education. Areas which seem promising for future satellite activity include bringing "open university" or "external degree" services to remote areas, and sharing of curricula, video programming, library and computer-based programming and resources among geographically dispersed institutions -- universities, colleges, or community colleges either intrastate or regional. Organizational, economic as well as technical factors need careful consideration.

This paper contains a review and analysis of previous and planned experience with satellite services in higher education, along with suggested areas and services for future development. An annotated bibliography of selected documents is included.

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I. STATEMENT OF OBJECTIVES

The primary purpose of this paper is to provide information and ideas to groups with interest in using communications satellites in higher education. The paper is being undertaken as one of a series of "Educational Satellite Commissioned Papers" sponsored by the National Institute of Education to aid in planning for a four-year, multi-million dollar program of educational satellite activities. A stated aim of the NIE effort, which also serves as a focus for this paper, is to deliver educational services to populations which are widely dispersed and geographically disadvantaged, and which currently lack quality educational services.

In keeping with the work statement for this paper, an effort has been made to address realistic and practical applications via satellite, and to present the material in an accessible manner to potential users who are about to conceptualize and begin the planning process. Large user groups such as regional and state organizations are among those NIE plans to work with in this effort. This paper seeks to provide specific suggestions as to how satellites can be used in higher education and how user groups can develop effective delivery mechanisms for utilizing satellites to serve the needs of their constituencies.

II. EDUCATIONAL SATELLITE APPLICATIONS

A. Introduction.

Figure 1 illustrates how various program sources might be delivered via an educational satellite system to various ground distribution centers and facilities. Table 1 lists primary roles for satellites in delivery of selected educational communications media and services. Table 2

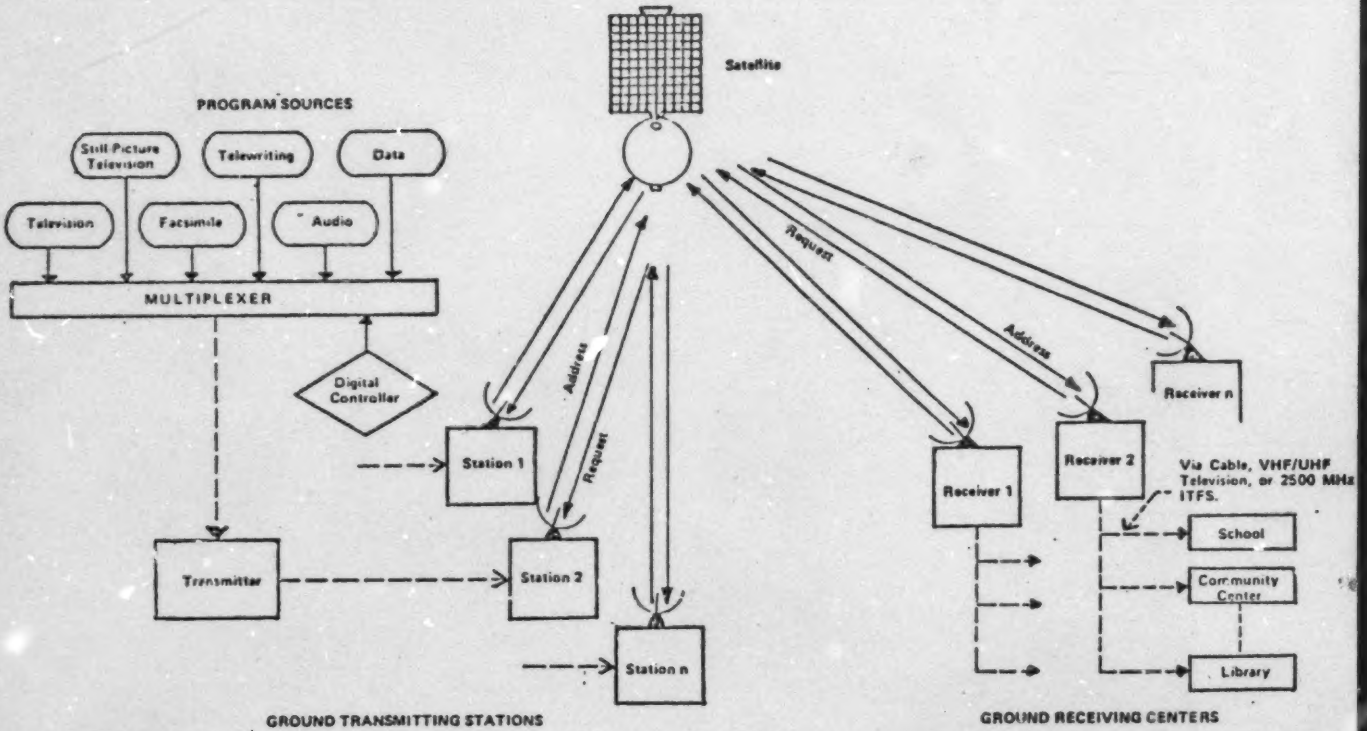

Figure 1: EDUCATIONAL SATELLITE SERVICES*

*from Ref. [C1]

Table 1: Primary Roles for Satellites Towards the Delivery of Certain Educational Communications Media and Services*

SERVICE	PRIMARY ROLES FOR SATELLITES
Instructional Television	Direct delivery to schools and learning centers, to broadcast stations, ITFS and cable headends for further redistribution.
Computer-Assisted Instruction	Delivery of CAI to small, remote institutions, particularly those 70-80 miles or more away from a major metropolitan area.
Computing Resources	
Multi-Access Interactive Computing	Delivery of interactive computing to remote institutions for the purposes of problem solving and implementation of regional educational information systems.
Remote Batch Processing	Delivery of raw computing power to small, remote institutions for instructional computing and administrative data processing.
Computer Interconnection	Interconnection of the computer facilities of institutions of higher education and regional computer networks for resource sharing.
Information Resource Sharing	
Interlibrary Communication	Interconnection of major libraries for bibliographic search and interlibrary loans, etc.
Automated Remote Information Retrieval	Interconnection of institutional and/or CATV headends with major information storage centers.
Teleconferencing	Interconnection of educational institutions for information exchange without physical movement of the participants and for gaining access to specialists.

*from Ref. [C1]

Table 2

Educational Telecommunications Services

1. Television Instruction
   a. One-way Distribution;
      i. Live and/or Prerecorded
      ii. Viewed when broadcast or recorded for later viewing
   b. With Audio or Digital Feedback
   c. Two-way Video
   d. Still-picture or Slow-scan Video
2. Radio (Audio) Instruction
   a. One-way Distribution
   b. Two-way Audio
3. Computer-Assisted Instruction and Administration
   a. Computer-assisted Instruction
   b. Computer-managed Instruction
   c. Computerized Career Guidance Systems
   d. Computerized Educational Information Systems (Record Keeping and Evaluation)
4. Computer Resource Sharing
   a. Computerized access to large computers by smaller institutions for problem solving, research, etc.
   b. Interconnection of computer facilities of institutions for increased computing capability, regional networks
5. Library and Information Resource Sharing
   a. Interlibrary loan ordering (audio)
   b. Interlibrary document transmission (fascimile)
   c. Remote, computerized bibliographic searches
   d. Access (computerized or other) to specialized information sources; data banks; information networks

(continued)

Table 2

Educational Telecommunications Services
(continued)

6. Teleconferencing

   a. Audio Only

   b. Video

7. Telewriter or Electronic Blackboard

contains a listing of educational telecommunications services which might be utilized in higher education. The discussion which follows will be structured around the seven main service categories listed in Table 2. Included will be a description of any previous satellite experiments or demonstrations within the various categories. Also included are comments concerning the manner in which such services might be used within higher education.

The phrase "higher education" is used to encompass a variety of post-secondary education activities. The higher education sector includes universities, four-year colleges and two-year community colleges. Instruction can take place in a campus setting or via a variety of emerging non-traditional mechanisms such as "open universities", "external degree" programs, and "universities without walls." Included are "in-service" education or training at the post-secondary level and continuing professional education.

B. Television

Television is probably the most familiar medium which might be delivered via satellite. Early satellite experiments in education utilizing NASA's ATS-1 and -3 satellites did not carry television signals because of limited spacecraft power in frequencies of interest. Commercial satellite systems now operating can deliver television signals but require large expensive earth terminals to receive the signals which must then be distributed through a local terrestrial distribution plant.

NASA's ATS-6 spacecraft provided the first opportunities to experiment with television distribution via satellite to relatively inexpensive earth terminals. The Health/Education Telecommunications (HET) demonstration which involved Alaska, the Federation of Rocky Mountain States and

the Appalachian Regional Commission utilized television in several modes [S1, S2, S3]:*

1. One-way distribution of both live and pre-recorded television programming for direct viewing.
2. Television with audio and/or digital feedback in which viewers could respond to programs shown.
3. A Materials Distribution Service in which television transmissions could be recorded and then replayed at a later time at the user's convenience.
4. Slow-scan and/or still-picture television.
5. Two-way television in which students can see the teacher and vice-versa simultaneously, or for remote medical diagnosis and conferences.

In the HET demonstration, much of the focus was on reading and career education, reflecting in part the priorities of the users and in part those of the funding agencies. One strong element of higher education involvement was teacher training for graduate credit. In the Appalachian region, some 1200 teachers completed in-service courses for graduate credit awarded by 14 Appalachian institutions of higher education. These courses in the teaching of reading and career education utilized a mix of live 3/4 hour to 1 hour video seminars and 1/2 hour pre-taped video programs. Live seminars permitted immediate audio interaction between the instructor at the central television studio and the teachers, i.e. the students at the receiving sites. Programs were delivered from a Resource Coordinating Center (RCC) at the University of Kentucky to teachers at several Regional Educational Service Agencies (RESA's).

*See Bibliography at end of this paper.

An interesting institutional aspect of the Appalachian experience is that the institutions of higher education both provided free tuition credit in some cases to teacher participants and did not set the standards for successful performance. Presumable, the latter was left up to the developers and implementers of the courses at the Appalachian Regional Commission and/or the RCC. Thus, the organization which emerged functioned to some extent like a regional university and provided the geographic coverage needed to take advantage of satellite technology.

The Materials Distribution Service utilized by the Federation of Rocky Mountain States portion of the HET demonstration consisted of transmitting films and video tapes via satellite for rebroadcast at the user's convenience. According to the Federation, in the 1974-1975 academic year, a total of 162 hours of satellite time were used for this service, resulting in 7,068 recordings being made and 190,078 viewings of these recordings. Although most of the effort was directed towards rural education below the higher education level, the service itself is obviously not restricted to any particular category. In-service teacher training was the only "higher education" portion of the Rocky Mountain activity and was less prominent than in the Appalachian region.

In utilizing the Materials Distribution Service, it was found that there was not sufficient satellite time to meet all film requests from participating sites. Should this turn out to be the case in the future, it may be that technical developments in video compression will help alleviate the problem. In addition, there are several systems in various states of development which fall into what might be described as "still-picture television"; that is, they deliver television programs which consist of a sequence of still pictures accompanied by continuous

audio.* Whether the software for such systems proves to be attractive and plentiful remains to be seen.

The two primary sources of the films and tapes for the Materials Distribution Service (MDS) were the Encyclopedia Britannica Educational Corporation and the Great Plains National Instructional Television Library. The extent to which these sources would be useful for providing films for direct instruction in college or university classes is unknown by the author.** Utilizing such a service also raises the copyright question. Because of copyright restrictions, public television stations involved in the Rocky Mountain HET segment could not utilize the MDS. Evidentally however, participating sites not tied to public broadcasting could and at the end of the MDS program, an arrangement was negotiated with Encyclopedia Brittanica to allow sites to purchase videotaped titles at "relatively low cost." [S2]

A potentailly significant element in educational satellite utilization in higher education is public broadcasting. The Corporation for Public Broadcasting and the Public Broadcasting Service, along with the more than 200 public television broadcasting stations throughout the U.S. represents a major resource which interfaces to some extent with education. It's role in the HET demonstration seems to have been

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*For example, the "VIDAC" system described by Nelson in Ref. [G1] was used in the Veteran's Administration ATS-6 experiments [S6]. Other systems include "Video Voice" mentioned by Cummings in [G1] and "Telecourses," being readied for the community college market by a subsidiary of Goldmark Communications. For an early detailed exploration of the potential of still-picture television, see Ohlman [C12].

**Cummings in Ref. [G1] indicates that efforts are underway to collect the information necessary to prepare "single, national, all inclusive catalogs of all film and video educational materials extant."

somewhat restricted, serving as one of several local mechanisms for distributing television programming as well as being involved in special events. Public television is moving forward with plans for a satellite interconnection to replace the current terrestrial net they lease from AT&T. Local public television stations broadcast college course offerings with credit awarded by local universities. Their current overall network coverage is fairly extensive although the HET demonstration extended to places that public television currently does not reach. Their role in future satellite development which directly impinges upon higher education remains to be determined. A number of public broadcasting stations which are members of the Southern Educational Communications Association (SECA) are in the process of defining an experiment for the CTS satellite, which may or may not involve higher education.

One of the major university applications of satellites to date has been the WAMI Experiment in Regionalized Medical Education. The WAMI program is a cooperative effort among the states of Washington, Alaska Montana and Idaho in which the only medical school in those four states, namely the University of Washington (Seattle) School of Medicine cooperates with institutions in the other states to train future physicans and improve health care throughout the region. In the WAMI satellite experiments on ATS-6, a "University Phase" consisted of delivering basic science instruction to WAMI students at the University of Alaska via satellite television originated at the University of Washington. In addition, a variety of other activities were carried out via satellite, including 1) conducting admissions interviews for Alaskan applicants to the University of Washington School of Medicine; 2) WAMI administrative conferences and student affairs sessions in counseling; 3) patient care in the form of teleconsultations.

An interesting feature of the WAMI ATS-6 satellite experiments is the use of full two-way color video and audio. Between Fairbanks and Seattle, it was possible for the television instructor to see the classroom on the screen at the same time that the class viewed the instructor. Such two way video/audio was also used in remote diagnosis and medical consultation. In the "Community Phrase" between Seattle and Omak, Washington, equipment was such that black and white video along with audio could be transmitted from both locations but not simultaneously. Alternatively, simultaneous one way video and audio along with return audio were possible in either direction. An interesting use of the facilities at Omak were medical student case study presentations of patient problems via satellite. [S4, S5]

Since completing the initial ATS-6 experiments, WAMI has proposed a follow-on experiment using the CTS satellite, which was launched by NASA in 1976. Although similar to the ATS-6 WAMI activity, there are some additional uses of television worth mentioning. First, an Independent Learning Program was proposed to deliver continuing medical education via satellite to National Health Service physicians and other practicioners in isolated communities. Those with satellite access will be able to interact an hour each week via satellite (presumably by audio feedback to the video programs?)* with a medical school faculty tutor. In the component called Regional Sharing of Faculty and Resources, videotapes will be mailed to classrooms at other campuses and satellite time will be devoted primarily to discussion and clarification. The idea here is to have highly specialized medical faculty present, via satellite television, clinical correlations of basic science principles which medical students are studying at other campuses. An Admission and Recruitment

*Evidently, some use of CAI for continuing education for physicians is also planned.

of Minorities portion will use two-way satellite video/audio as a means of interviewing prospective medical students and providing information about career choices. In Utilization of the Consultation Process the CTS satellite will continue to allow, as in the ATS-6 experiments, students and physicians at remote community sites to present patient cases to faculty at Seattle.

Another experiment to be performed on the CTS satellite is the Digital Video College Curriculum Sharing Experiment in which Stanford University in California and Carleton University in Ottawa, Canada will transmit engineering classes and seminars to each other. [S7]* Major objectives include demonstration of the ability to expand the scope of university instruction by sharing classes between universities with different emphases and orientations, and the development of strategies to administer and manage curriculum sharing between universities effectively. The primary program content will be regularly scheduled engineering courses with each institution selecting courses the other normally doesn't have available. Television programs can be transmitted simultaneously from each campus with audio feedback for each class. Alternatively, two-way video/audio teleconferencing can also be utilized for special discussion seminars, student counseling and problem sessions.

A technical feature of the experiment is the use of video compression to transform the television picture to a form in which it can be transmitted with less bandwidth and power than in normal transmission. Such a technique could improve the ability of satellites to provide a

*See also the article by Guild, P. D. et al. in Ref. [G1].

materials distribution service as discussed previously without going to a slow-scan or still-picture television mode.

This review of television utilization in satellite experiments has illustrated a number of ways in which television has been and can be used. Interestingly enough, much of the activity to date in the field of "higher education" can be categorized as that of continuing professional education or "in-service" professional education. In Appalachia as well as other regions, ATS-6 was used for graduate teacher education and in-service training. The WAMI experiments represent probably the most ambitious attempt to date to use satellite television in a variety of ways in higher (medical) education. The forthcoming Stanford-Carleton experiments in curriculum sharing may be the first time that satellite television is used for undergraduate course instruction. To my knowledge, in spite of a great deal of talk, there has not yet been any use of satellites to transmit televised courses to community colleges, state colleges within or among large state systems, or to "open university" participants such as those enrolled in the University of Mid-America. These uses could conceivably involve far greater numbers of students than either private universities or medical schools.

C. Radio (Audio)

Although radio (or audio) has been eclipsed by the rise of television in the U.S., its cost is low relative to television. It was the primary medium used in the ATS-1 and -3 satellite experiments and continued to be utilized in the ATS-6 experiments for interaction and feedback. In this section, it's use in the PEACESAT Project is described

in some detail because of its focus on higher education. Its use for rural teacher education in Alaska is also discussed.*

The stated purpose of the PEACESAT Project (Pan Pacific Education and Communication Experiments by Satellite) is to demonstrate the benefits of currently available telecommunications technology when applied specifically to the needs of sparsely populated, less industrialized areas of the world. The project, initiated by the University of Hawaii, provides an "intercontinental laboratory to develop improved communication methods of education, health and community services in the Pacific and a base for long range planning."

PEACESAT has been operating and under development since April 1971 and uses NASA's ATS-1 satellite. The system utilizes low cost ground stations with both receive and transmit capability. These terminals, costing from $2,500 to $7,000 each, permit one-way voice from all locations. Some capability and experience exists for facsimile telecopiers and teletype writers. Slow-scan television and wired blackboards may be tried in the future. Evidentally, capability for interconnecting these media exists but limited satellite time has been a problem. (See article by Misko in Ref. [G1]).

A pilot educational satellite system linking Hilo (Island of Hawaii) and Honolulu (Oahu) began operating in April 1971 and is claimed to have offered the first college course taught via satellite, the first satellite interconnection for library networking and the first intrastate satellite network in the U.S. In January 1972, universities of other countries were added to the system. According to PEACESAT literature, time zone

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*Most of the information in this section is from Ref. [C1]. Original sources are listed in that document.

differences and language and dialect differences have not been a problem. [C1]

As of February, 1972, ground terminals had been established at the University of Hawaii-Manoa Campus (Island of Oahu); Hawaii Community College Campus and Hilo College (Island of Hawaii); Wellington Polytechnic Institute of Wellington, New Zealand; and the University of the South Pacific at Suva, Fiji. Ground terminals were also being test-operated or planned for a variety of other locations in the pan-Pacific area.

In June, 1971, two classes, Speech 150 in Hilo, Hawaii and Speech 145 in Manoa Campus, Oahu, participated in joint activity via satellite. Students engaged in game activity, using two-way voice communications. Facsimile transmissions were also used. Activities concentrated upon included intelligibility, problem solving, information gain, communication of feelings, and determining attitude from speech expression. An important aspect of this experiment was the use of interactive, two-way communication which is deemed of particular importance in interuniversity cooperation of a cross-cultural or trans-national setting.

Other university level uses include teleconferencing and instructional exchange among widely scattered participants in such subjects as political science, geography, English as a second language, Spanish, Indonesian, communication and teacher education. Subjects of mutual interest discussed by participants have included student government, Pacific Island broadcasting, foreign investment, race relations and ethnic studies. Special projects dependent upon the system are developing including a student newspaper news exchange, a non-commercial radio news service, and international debates on subjects such as tourism.

Other uses of the system have included the transmission of library materials from one campus in Hawaii to another which has appreciably speeded up service. Formerly, Hilo faculty wishing Hamilton Research Library materials waited three to nine weeks for the materials to arrive. Using PEACESAT, orders are transmitted over the system via facsimile (xerox). Short magazine articles are delivered over the system within 48 hours and books by mail within 96 hours. The service was to have been extended between the University of the South Pacific and Hawaii. [C1]

PEACESAT has also been used for communication related to research to combat starfish invasions and disease epidemics, for medical consultations concerning infectious diseases, by the Hawaii Agricultural Experiment Service to conduct seminars with its offices and agents, and to broadcast the investiture of the Chancellor of the University of Hawaii.

A recent article by Misko* summarizes the spectrum of PEACESAT activities as follows: 1) Classroom Instruction, 2) Decision-Maker Conferences, 3) Professional and In-Service Training, 4) Community Development Seminars, 5) Research Support, 6) Professional Consultation and 7) Technical Development. Classroom instruction has included both complete courses and enrichment activities. Students from three different far-flung universities took part in a jointly-staffed credit course on Comparative Pacific Education. A new course in Communication involves satellite tutorials with feedback as well as taped audio cassette review lectures, a self-study workbook and local field study. PEACESAT has continued to expand its activity to include other universities in the Pacific region. The backbone of this activity is a

*In Ref. [G1].

relatively inexpensive, satellite-based, interconnected audio network involving regional curriculum development and student tutorials.

Beginning on January 22, 1973 the National Education Association in conjunction with its state affiliate, the Alaska-NEA and the College of Education of the University of Alaska conducted a 16-week satellite radio series involving teachers in 17 Alaskan villages. Teachers could take the course, which was coordinated by the Rural Teacher Corps Project, for one credit in the College of Education. ATS-1 was used along with the National Institute of Health's satellite uplink and studios in Bethesda, Maryland. Teachers in one village could talk to teachers in other villages as well as to individuals at the University of Alaska and three NEA staff members at Bethesda. Six persons took the course for credit and others audited. The satellite seminars, which featured two-way voice interaction, covered a range of topics relevant to Alaskan teachers.

Audio also seems to have been a not insignificant part of the ATS-6 satellite activity. Not only was it used as a means for feedback to video broadcast but in Appalachia, a four-channel audio system was used as follows. After viewing a television program, teachers were asked a series of questions describing a hypothetical teaching situation and outlining four possible approaches to the problem. The teachers could respond by pressing a button on a response pad.* Responses could be tabulated and explanations of the merits of a particular response could be heard. Some audio instruction was also transmitted in addition to the television programs.

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*A digital response system was originally planned for the Rocky Mountain Region but received only limited testing due to budgetary limitations.

Although audio or radio by itself would appear to receive less attention as satellites develop more capability, it might well be worth keeping in mind, particularly if resources are scarce or for regions where television has not yet become a "psychological necessity." The experience in the Pacific region and Alaska seems to illustrate the utility of this medium.

D. Computer-Assisted Instruction

The phrase "computer-assisted" or "computer-aided" instruction (CAI) has been used somewhat loosely and in various ways. One interpretation is that of a man-machine relationship in which the computer is used to aid and abet both teachers and students in the process of education. Aid to the teacher can come in the form of diagnostic or prescriptive information to assist the teacher in making decisions about what activity students should undertake next. This latter process is usually called "computer-managed instruction," (CMI). Most CAI efforts include CMI but not vice-versa. [C1]

CAI started in the 1960's and is still a relatively new phenomenon. "Drill and practice" CAI programs are the most common. In such a program, a student sits in front of a display device and a problem is presented on a screen or a teletypewriter printout. The student responds to the problem by pushing a key or using a light pen. The terminal, which is connected to a computer, indicates whether or not the student has responded correctly and, based on the response, gives the student a new problem. In CMI, track is kept of student performance on CAI programs and the results are used to select new work for the student.

Some CAI efforts go beyond drill-and-practice and seek to teach concepts, values or skills. Computer-aided gaming and simulation are adding to the arsenal of educational tools that the computer provides.

The National Science Foundation has been sponsoring the development of two CAI systems which are being used in higher education. The PLATO project has resulted in extensive development of university CAI courses at the University of Illinois campus and in the PLATO-IV version, CAI being extended to other locations. The TICCIT system developed by the MITRE Corporation is being used to deliver CAI to two community colleges, with software being prepared by Brigham Young University. Software development is geared towards materials that can be used broadly in basic junior college courses. [C1]

Because of the potential of CAI in education and its status as a developing technology it would seem reasonable to expect that educational satellite activity would have included CAI as well as computer-resource sharing (see next section) as part of the spectrum of experimental services. However, to date, experience with satellite delivery of CAI is virtually nil.

One of the earliest efforts to use satellites to deliver CAI involved Stanford University, the ATS-3 satellite and the Isleta Pueblo, one of 19 American Indian Pueblos in New Mexico. Ten teletype terminals were originally intended to be linked via satellite to a computer at Stanford University for drill-and-practice elementary education. Technical difficulties developed and a telephone connection between Stanford and Isleta was used instead. Because of high telephone costs and continuing technical problems, a mini-computer was installed at the Isleta site in 1973. [C9]

The WAMI ATS-6 Experiments had a computer-aided evaluation (CAE) component in which students at the University of Alaska were to evaluate their own proficiency using a computer-aided instruction program on the Ohio State computer. Computer terminals at Fairbanks, Alaska were connected via ATS-6 to Tymeshare Corporation's line in Seattle which in turn was linked terrestrially to the computer in Ohio. Using these terminals, students were to answer study course questions and receive feedback to the correctness of their answers (presumably drill-and-practice CAI). The purpose of WAMI's CAE component was to evaluate the effectiveness of the computer link in monitoring student progress (CMI) and evaluating curricula. [S4]

Only three successful CAI sessions were conducted. Technical and scheduling problems and delays plagued the effort. According to a WAMI report, in July 1974 "the CAE experiment was jeopardized by AT&T's refusal to allow the University of Washington to connect it's peripheral equipment to their regular long-distance dial system. As certain of their long-distance connections could involve the use of a satellite, AT&T expressed concern that two satellite links in series might introduce an unacceptable signal delay and possible degradation to the system performance." [S4]

Perhaps the most ambitious test of CAI via satellite to date was conducted by the Veterans Administration in their ATS-6 experiments. There were two components under the category of computerized events. One involved the delivery via satellite of computer-aided instruction programs in clinical decision making, located in Salt Lake City, Utah to terminals in Altoona, Pennsylvania. A primary objective of this effort was the training of nurses. The other CAI activity utilized a

psychiatric histories by responding to a series of questions. This computer-managed program was to be delivered via satellite and tested at Salisbury, North Carolina as an aid in VA psychiatric hospitals for early patient evaluation, prior to case disposition, and for more effective managment and treatment.

The CAI efforts by the V.A. were plagued by difficulties, mostly of a technical nature from the outset. These difficulties are well documented in the final report on the V.A. project. [S6] Most of the problems involved ATS-3 but there were other problems involving AT&T and some of a non-technical nature. Applied Communications Research, an organization which evaluated the experiments, found that: "The two computer events were inconclusive. Both events appear to have been well received but technical problems obscured whatever qualities the software might possess." The VA submission for the CTS satellite contains no computer component. The Evaluation team also suggests that alternatives to satellite transmission due to advances in the computer industry should be considered for CAI delivery.

E. Computer Resource Sharing

The essential rationale behind computer resource sharing is to provide institutions which may lack computing capability with access to the computing resources* of other institutions. Generally, such a network ties a number of smaller institutions to a larger institution. For example, Dartmouth College, a pioneer in university computing, serves one university, one community college and seven undergraduate colleges.**

*"Resources could include computer programs as well as core storage. If there can be a Materials Distribution Service for videotapes and films, why not for computer programs through a "Project Conduit" type auspices?

**Many "non-CAI" uses of computers in higher education are discussed by Luehrman in Ref. [G5].

During the period from 1968-1972, the National Science Foundation funded the establishment of some 25 experimental regional computer networks. Such networks can be used for research, instruction or administration. The benefits to be derived from such an arrangement and the tradeoffs between such networks on one hand and minicomputers on the other have been explored elsewhere. [C1]

A survey of computing facilities was carried out in 1972 by Singh and Morgan in connection with a study sponsored by the Appalachian Regional Commission. [C8] Respondents at about half of the region's colleges felt that existing computing facilities were adequate to meet current needs whereas about 40% felt that existing capabilities fell short of what is needed. Only nine of 123 institutions with some form of computing capability reported a surplus of that capability. Figure 2 illustrates various applications of computers in education. The last three horizontal rows are pertinent to higher education.

To date, the use of satellites for computer resource sharing has been almost non-existent. In September, 1968, the University of Hawaii initiated a research program to investigate the use of radio communications for linking computers together. The remote-access computer system called the ALOHA System being developed as part of that program is to link interactive computer users and remote access input-output devices at community colleges and research institutes away from the main university campus to the central computer via UHF radio communication channels.

The ALOHA System has utilized satellites in two ways. The ATS-1 satellite and small (~$5,000) ground stations were used to operate a random access burst mode data channel between the University of Hawaii and NASA/Ames Research Center in California. Plans called for the

	Instructional Applications of Computers					Administrative Applications of Computers					Research Applications of Computers							Library Applications			
	Instruction about Computers			Instruction with Computers							Research on Computers			Research with Computers							
	Specialist Instruction	Service Instruction	Survey Instruction	Computer Assisted Instruction/ Computer Based Instruction/ Computer Managed Instruction	Computer Assisted Problem Solving	Computerized Financial Operations	Computerized Personnel Management	Computerized Program Management	Computerized Facility Management	Hardware Oriented Research	Software Oriented Research	Research on Theory and Science of Computing	Number Processing	Symbol Processing	Data Processing	Event Processing	Picture and Sound Processing	Circulation Automation and Computer Aided Cataloguing	Computerized Indexing and Retrieval	Computer Aided Vocational Guidance	
Elementary Schools				X		X	X	X	X						X					X	
Secondary Schools			X	X	X	X	X	X	X						X			X			
School District						X	X	X	X						X						
Vocational Schools	X		X	X		X	X	X	X						X					X	
Community Colleges	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X		X	X		
Colleges	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
Universities	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		

*from Ref. [C1]

Figure 2. Computer Applications in Education*

University of Alaska to join this network in 1973 and for extension of this network to ground stations in other countries. [C1]

In January of 1973 a meeting was held at the University of Hawaii to plan the development of a Pacific Educational Computer Network. The Aloha System could develop such a network using wide-area satellite communications in the "packet communications" mode to permit sharing of specialized computing resources and low-cost utilization of computers located in differing time zones during off-peak hours. To my knowledge, the network has not yet been implemented.

F. Library and Information Resource Sharing

There are a variety of activities in which information is being or might be shared among institutions and users in higher education. The library is an important element in colleges and universities. Interlibrary loan services permit one library to make use of the resources of others. Although the mail and the telephone are by far the most common means of ordering interlibrary materials, teleprinters are also used. Telefacsimile, a process by which hard copies of individual pages can be transmitted electronically, has been used only sparingly due to economic and technical factors but technical advances could make such a service more attractive.

Libraries are also beginning to make use of computerized bibliographic search services, offered by either public or private organizations. Specialized services are available for both medical and non-medical applications.

Other examples of information resource sharing include tapping a large, unique source of information such as the National Library of Medicine via an information network configuration. The National Science Foundation has supported the development of regional information

networks for specialized science subjects like chemistry. Another form of information resource sharing might involve the development of an educational information system within a large state university system to aid in record keeping and other administrative matters. Computers may be utilized in some of these activities.

Library and information resource sharing has played a minor role in satellite activity to date. The Lister Hill Center at the National Library of Medicine (NLM) has sponsored a demonstration of the utility of satellite communications in this field by means of ATS-1, linking the National Library of Medicine, the University of Alaska, the University of Wisconsin and Stanford University.* [C1] NLM also has proposed a more extensive experiment involving medical research dissemination, continuing education, teleconferencing, and effectiveness and efficiency of the communication system for CTS. [S7]

The Satellite Library Information Network ("SALINET") proposed for CTS is to involve the University of Denver Graduate School of Librarianship, the University of Kansas Libraries, the Bibliographical Center for Research of the Rocky Mountain Region, Inc., and several other organizations. Among the activities to be undertaken are compressed bibliographic data transmissions, in-service training of librarians and resource sharing via access to specialized centers such as the Denver Public Library's special conservation library of Western History Collection. [C1, S7]

Another proposed CTS experiment which seems to have been abandoned was to involve the operation of a satellite-linked prototype facsimile network by the New York State Library, interconnecting seven regional

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*ATS-1 was used in a project sponsored by the Alaskan Library Association for non-university purposes.

networks centered in places as scattered as Juneau, Alaska; Los Angeles, California; Springfield, Illinois; and Albany, New York. In this experiment, pages were to be copied directly from bound library volumes and transmitted electronically, using satellites for long-distance transmissions. The experiment was to serve primarily researchers in several fields, legislators and businessmen with interconnections to both the Library of Congress and the National Library of Medicine.

The Appalachian portion of the ATS-6 experiment had an information retrieval component built in to support its effort at teacher education and training. Teachers were given access to several computer-based information retrieval systems which contained information pertinent to teaching reading and career education: The Computer-Based Resource Unit (CBRU), the Texas Computer Retrieval System (CRS), the Select-Education Prescriptive Materials Retrieval System (PMRS); as well as computerized index tapes to the Educational Research Information Centers (ERIC) and Abstracts in Instructional Materials and Abstracts in Research Materials (AIM/ARM). The satellite role seems to have been limited to transmitting television programs explaining to teachers how to fill in order forms for the Texas CRS as well as being used for voice transmission of information requests and voice responses. Other potential uses which were handled by ground facilities were facsimile transmission and teletype transmission. [51]

G. Teleconferencing

Teleconferencing involves communication between or among individuals at two or more locations. It can be accomplished using voice only, using video, or even using computers. The simplest example of a teleconference is a telephone call between two individuals. More complicated examples might be a videoconference involving individuals at several

locations or a on-line computer-based "Delphi" study such as that carried out in the "Forum" program on the ARPANET.

The teleconferencing idea has attracted a lot of attention lately because of its potential for substituting telecommunications for travel. Elements of teleconferencing have cropped up in several of the satellite experiments described in the proceeding pages. These include the audio interchanges in the PEACESAT ATS-1 experiment, the interactive 2-way video of the WAMI ATS-6 experiment, the teleconsultations for remote medical diagnosis in the VA and WAMI ATS-6 experiments, and the video "teleconferencing" between NASA-Ames, Stanford University and Carleton University on CTS.

H. Telewriting; Electronic Blackboard

An early Arthur C. Clarke article speaks of an electronic blackboard as a low cost device for delivering education via satellite to aid in international development. Such a device could display simple graphic along with audio accompaniment. The idea has not caught on widely. In the U.S. a device called the electrowriter has been used by several universities to deliver lectures to off-campus or branch-campus locations. The University of Illinois is currently using a new experimental, all digital system developed by Bell Labs, in which blackboard writing is transmitted electronically to an off-campus television screen via telephone lines. Telewriter or electronic blackboards require less bandwidth than television and could conceivably be of future interest for satellite delivery.

III. CONCLUSIONS AND RECOMMENDATIONS

The previous review and analysis of educational satellite experiments and applications sheds some interesting light on the opportunities,

priorities and limitations of satellite delivery for higher education. In many respects, higher education has been represented in satellite activity but in a less direct way than might have been anticipated. Most of the educational activity in the HET ATS-6 experiments was centered on elementary and secondary education, in part because of both user priorities and funding availability. Higher education was involved through graduate teacher education or in-service teacher training. However, relatively little of the experience to date has been in the main stream of the higher education sector.

Some of the more extensive university activity came in the health portion of HET. The WAMI experiments involving universities in four states demonstrated the use of satellites to share the resources of the University of Washington in medical education in a variety of ways. This professional thread extends to the CTS experiments in which two engineering schools are involved in a curriculum sharing experiment.

The early ATS-1 experiment in the Pacific region involved extensive use of audio communications for university level undergraduate courses and other applications. This activity is continuing and has involved more institutions with time.

From a telecommunications services point of view, the media with which the most satellite experience has been accumulated to date have been audio and video. Due to the limited capability of ATS-1 and -3, audio was the medium of both choice and necessity. The utility of audio for feedback in connection with video was demonstrated on the ATS-6 experiments. One-way video, one-way video with audio feedback and two-way video have all been tested on ATS-6, the latter in medical-related activity. Still-picture or slow-scan media requiring bandwidth between that of audio and video have also been experimented with. In

the Rocky Mountains, a materials distribution service delivered films and videotapes via satellite for replay at the user's convenience.

Efforts to distribute computer-aided instruction via satellite seem to have run into considerable difficulty, either because of technical problems or other organizational or institutional factors. It is probably fair to say that to date, there really hasn't been a well structured, well supported test of either computer-aided instruction or of computer or information resource sharing via satellite. These are areas in which new knowledge might be generated in future educational satellite activity.

Over a year ago, we summarized our impressions of the state of large-scale educational telecommunications utilization in higher education as follows. [C1]

> There would appear to be considerable activity in higher education involving communications media and technology, particularly in large state universities and at the community college level. Extensive involvement with computers for research and administration is a reality, and regional computing networks are coming into being. The federal government has supported a number of large-scale projects (PLATO, TICCIT, SUN-UMA, Regional Computing Networks, etc.) of a type which are necessary to answer key questions concerning further technology-based development. A number of surveys and forecasts predict extensive utilization of technology for instruction within the next ten to twenty years, particularly in more non-traditional forms of higher education.
>
> Potentially promising applications in higher education for which a large-scale educational telecommunications system may find acceptance include:
>
> A) Reaching wider populations of college students through televised and computer-aided instruction. There is increasing emphasis on "external degree" programs, i.e., programs in which students receive a significant portion of their education off campus. The N.I.E. supported State University of Nebraska open learning project and its extension to a regional setting through the University of Mid-America will be an important step in the development of open learning systems using television. The outcome of N.S.F. supported demonstrations of PLATO and TICCIT CAI systems at the community college level are also of importance.
>
> B) Continuing professional education
>
> A growing number of universities deliver instruction via television to individuals at industrial and other locations. The Surge Program in

Colorado uses videotapes to provide graduate engineering courses to an extensive audience. Some 15-20 universities have developed similar programs using a variety of delivery mechanisms including videotapes, microwave, and ITFS. Wong found in a recent survey that the directors of these networks were optimistic about future growth and interested in participating in the expanded regional or national network arrangement. Whether such an arrangement would be cost-effective remains to be investigated.

C) Regional computing networks and information networks.

There are some thirty examples of regional computing networks in which a large central facility serves a number of outlying colleges. Specialized information networks for various disciplines (health, science, etc.) and for library sharing are being created. Depending upon support and acceptance, it is possible that these kinds of activities will grow in the future.

To date, the "open university" idea embodied in A, above has not been implemented to any extent using a satellite. Such a concept might be appealing to a large state university with several campuses or to several institutions spread over a large region. Specific elements which might be distributed via satellite include television, radio and computer-assisted instruction, as well as information and computer resource sharing for purposes of research, instructional support and administration. Programs could be delivered to students from a central location to homes, learning centers and branch-campuses, with provision for feedback and interaction. I do not underestimate the considerable organizational, managerial and other problems associated with such an undertaking.* But it seems as though the time may be ripe to give it a try, particularly if a real need can be demonstrated and if such a system succeeds in providing access to higher education for those who want it but could otherwise not afford it.

Televised programming could also be delivered from a central campus to other campuses as in the case of the basic sciences component

*Some of these are well illustrated in papers by Dumolin and Morgan [C13] and Walkmeyer [C14].

of the WAMI experiments. Such resource sharing should also be possible in fields other than medicine. Some effort at pooling resources to produce television programs is currently underway in community colleges as well as in universities with technology-based networks for continuing engineering education. Public television stations may have a role to play in the distribution of university courses. The Southern Educational Communications Association (SECA) which involves a number of public television stations is a proposed experimenter on the CTS satellite.

University libraries have been hard pressed financially in recent years. A satellite-based activity involving interlibrary ordering, document facsimile retrieval, bibliographic searches, etc. might extend resources and needed services to geographically remote areas.

There has not been a successful test of CAI delivery by satellite. Activity involving ATS-3 have been singularly unsuccessful. CAI delivery via satellite makes sense if delivery is from a central point to a large number of dispersed, remote terminals. Bandwidth requirements can be sizable. [C6] However, if the need is there and the requirements are right, there is no reason why a successful test can not be made, given careful planning and adequate technical capability and resources. Private industry seems to do very well with digital data communication systems via satellite. Non-CAI computer resource sharing might be utilized as well.

The satellite as a medium of communication has demonstrated some interesting possibilities for both one-to-one, one-to-many, and small group communications. Both intercultural and intracultural communication might be utilized. For example, seminars might be held among geographically dispersed colleges with large numbers of members of the same cultural or ethnic group to share experiences and ideas.

Much of what can be done technically depends upon the capability of the satellite, the ground receiving equipment and/or the ground distribution network. It is important that these capabilities and their associated costs, along with who is going to pay for what be understood. Existing commercial communications satellites are low-power devices requiring large, expensive earth stations. The ATS-6 and CTS spacecrafts are high-power satellites but to date, the time on board that could be utilized in the past for any one experiment has been limited. Presumably, a future quasi-operational or operational educational satellite will have more time available for educational uses. Sticking with audio and video will likely entail less new technical development than developing computer-based instruction or computer and information resource sharing.

There is no lack of possible ideas for uses of educational satellites. After indicating that the educational ideas embodied into the ATS-6 projects "are not innovatively spine-tingling," Kreitlow in Ref. [G1] extracted some 14 ideas for use of a future eductional satellite system for the northern midwest region. They are included as Appendix A to this paper.

Ultimately the users or user organizations must decide which applications to implement and why. I have tried in this paper to lay out some of the tools that might be available if users choose to avail themselves of them. Some of these users have experience with satellite technology and others do not. For the latter, it is recommended that you talk directly with individuals who have been involved in previous satellite activity to gain first-hand information and impressions of the problems and possibilities.

IV. ANNOTATED BIBLIOGRAPHY

This annotated bibliography contains brief descriptions of a variety of documents which should be useful in planning for satellite utilization in higher education. The Bibliography is divided into three parts:

1. Documents C1 - C17, prepared at the Center for Development Technology, Washington University.
2. Documents G1 - G7 of a general nature.
3. Documents S1 - S7 which describe specific educational satellite experiments.

C1 - C17. Center for Development Technology Documents

C1. Morgan, R. P., Singh, J. P., Rothenberg, D. and B. E. Robinson, "Large-Scale Educational Telecommunications Systems for the U.S.: An Analysis of Educational Needs and Technological Opportunities," Memorandum 75/1, (425 pp.), April, 1975. (ERIC No. ED 105 898) [NASA-CR-142619]*

This report contains a great deal of information about technology utilization in a variety of educational sectors, including higher education. It also provides detailed descriptions of a broad range of

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*Reports for which ERIC ED numbers are given are available through the ERIC Clearinghouse on Information Resources of Stanford, California and should be purchased directly from ERIC Document Reproduction Service. Write to:

ERIC Document Reproduction Service
Computer Microfilm International, Corp.
P. O. Box 190
Arlington, Virginia 22210

Phone: (703) 841-1212

Reports bearing the NASA-CR designation are available from National Technical Information Service, Springfield, Virginia 22151.

Other selected documents may be available from the Center for Development Technology office. Inquiries should be addressed to:

Center for Development Technology
Washington University
Box 1106
St. Louis, Missouri 63130

educational telecommunications services which could be delivered by satellite.

C2. Walkmeyer, J. E., Jr., Morgan, R. P. and J. P. Singh, "Market Scenarios and Alternative Administrative Frameworks for U.S. Educational Satellite Systems," Memorandum 75/2, (168 pp.), April, 1975. (ERIC No. ED 107 268)

A companion volume to the above "Needs Analysis" report, this document explores expanded uses of satellites in education. Contains scenarios for satellite utilization in various aspects of higher education.

C3. Morgan, R. P., "Communications Technology in the Future of Higher Education in the United States," Proceedings of International Symposium on Communications Media in the Future of Higher Education, Deutsche Verlags-Anstalt GmbH, Stuttgart, Germany, pp. 60-67, 1974 (in German). Also available in English from ERIC, as No. ED 089 664).

Although slightly dated, this paper is probably the most comprehensive single paper available which attempts to summarize the status of and potential for communications technology utilization in U.S. higher education. Contains summary of satellite activity through 1973. Up-dated version of this paper was incorporated in "Needs Analysis" report [C1] listed above.

C4. Rothenberg, D., "Continuing Professional Education: Status, Trends and Issues Related to Electronic Delivery," Memorandum 75/5, (74 pp.), August, 1975.

A look at continuing professional education for four groups: doctors, lawyers, engineers and teachers, with emphasis on the status of and prospects for communications media utilization.

C5. Wong, M. D., "The Role of Technology in Non-Traditional Higher Education," M.S. Thesis, Program in Technology and Human Affairs, Washington University, Report No. (R)T-74/3, (307 pp.), August, 1974. (ERIC No. ED 094 760) [NASA-CR-140016/NTIS Accession No. PB 241320]

A comprehensive review and analysis of technology utilization in "non-traditional" higher education, with emphasis on technology-based networks which deliver instruction to off-campus locations.

C6. Morley, R., and L. F. Eastwood, Jr., "Alternative Network Designs for an Operational PLATO IV CAI System," Based upon M.S. Thesis by R. Morley, Department of Electrical Engineering, Washington University, Report No. (R)T-75/3, (125 pp.), August, 1975.

A careful technical and economic study of what it would take to deliver PLATO-IV CAI via satellite over large areas.

C7. Demerath N. J., and L. A. Daniels, "How to Make 'The Fourth Revolution'--Human Factors in the Adoption of Electronic Instructional Aids," Memorandum 73/5, (84 pp.), December, 1973. (ERIC No. ED 086 262) [NASA-CR-136862]

Interesting analysis of prospects and problems of getting U.S. higher education to utilize fully electronic technologies.

C8. Singh, J. P. and R. P. Morgan, "Communications Technology for Education and Health Care Delivery in Appalachia," Report prepared for Appalachian Regional Commission, July 1972.

A comprehensive look at the potential for using communications technology in general and the ATS-F (ATS-6) satellite in particular in that region. Contains results of survey of university ETV stations and computing facilities. Proved useful as a planning document to the Commission in connection with Appalachian ATS-6 experiments.

C9. Perrine, J. R., "Telecommunications Technology and Rural Education in the United States," M.A. Thesis, Program in Technology and Human Affairs, Washington University, Report No. (R)T-75/1, (283 pp.), March, 1975. (ERIC No. ED 106 009) [NASA-CR-142694]

Although not directed specifically at higher education, contains potentially useful information on communications technology utilization in rural settings, with emphasis on American Indians and migrants.

C10. Johnson, R. C., "Telecommunications Technology and the Socialization of Black Americans: Issues, Concerns and Possibilities," M.A. Thesis, Program in Technology and Human Affairs, Report No. THA-74/7 by THA Program and Black Studies Program, (350 pp.), September, 1974. (ERIC No. ED 096 988).

C11. Molden, V., "Telecommunications and Black Americans: A Survey of Ownership, Participation and Control," M.A. Thesis, Program in Technology and Human Affairs, Washington University, Report No. R(T)-75/2, (836 pp.), August, 1975.

These two documents taken together comprise a comprehensive analytical and planning base for utilization of telecommunications by Black Americans, covering all aspects of education.

C12. Ohlman, H. M., "Communications Media and Educational Technology: An Overview and Assessment with Reference to Communications Satellites," M.S. Thesis, Department of Applied Mathematics and Computer Science, Washington University, Report No. (R)T-71/1, (232 pp.), May, 1971. (ERIC No. ED 053 540 - microfiche only) [NASA-CR-122037]

Although somewhat dated, this report contains a great deal of interesting information about still-picture television, facsimile, and microimaging systems, among others.

C13. DuMolin, J. R. and R. P. Morgan, "An Instructional Satellite System for the United States: Preliminary Considerations," Memorandum IM-71/2, (36 pp.), July, 1971. (ERIC No. ED 055 428) [NASA-CR-122946]

An early document which, although centered primarily on elementary and secondary education, explores organizational and implementation aspects of educational satellite systems in some detail.

C14. Walkmeyer, J., "Planning Alternative Organizational Frameworks for a Large-Scale Educational Telecommunications System Served by Fixed/Broadcast Satellites," Memorandum No. 73/3, (112 pp.), June, 1973. (ERIC No. 078 663) [NASA-CR-133646]

This report explores several organizational issues of concern in educational satellite system design: including at the overall system level, access, integration, general organizational alternatives, hardware

control and development strategies; at the component level, program sources, storage/origination points, transmission, and local-regional distribution.

C15. Ballard, R. and L. F. Eastwood, Jr., "Telecommunications Media for the Delivery of Educational Programming," Memorandum 74/1, (143 pp.), November, 1974. (ERIC No. ED 100 349) [NASA-CR-140880]

Contains descriptive materials and associated costs for a variety of educational media, including educational radio and television, the TICCIT and PLATO CAI systems, and library and document transmission services.

C16. Morgan, R. P., "Potential Impacts of Educational Telecommunications Systems," J. Educational Technology Systems, Vol. 4, No. 2, pp. 77-98, 1975.

Potential impacts of large-scale educational telecommunications systems are identified and discussed, including impacts on education; economic impacts; political and legal impacts; social, psychological and cultural impacts.

C17. "Final Technical Report: Program on Application of Communications Satellites to Educational Development," September 1, 1969 - August 31, 1975.

Contains cumulative bibliography of Center for Development Technology, Washington University reports, theses, articles in the area of Technology, Communications and Education.

G1 - G7. Other Documents of General Interest

G1. Parker, L. A. and B. Riccomini, Eds., "A Report on University Applications of Satellite/Cable Technology," University of Wisconsin-Extension, June, 1975.

The only Conference proceedings I know of directly related to University applications of these two technologies. Contains about 25 brief articles.

G2. "Designing Diversity '75," Proceedings of 2nd National Conference on Open Learning and Nontraditional Study, June 17-19, 1975, Washington, D.C.*

Probably as good a source as any for an overview of the whole "open learning," "open university," "non-traditional study" movement in higher education. A broad spectrum of topics are covered, including satellites, the University of Mid-America, and the Open University in Great Britian. Complete with pencil sketches of the authors! Conference is held annually in June.

G3. Filep, R. T., D. J. Wedemeyer and J. P. Ballard, "Communications Satellites and Social Services: An Annotated Bibliography," Annenberg School of Communications and Learning Systems Center, University of Southern California, Los Angeles, 90007, November, 1975.

A recent, fairly up-to-date, annotated bibliography, focussing on users and evaluations.

G4. Morgan, R. P. and J. P. Singh, "A Guide to the Literature on Application of Communication Satellites to Educational Development." An ERIC paper issued by ERIC, Stanford, California, April, 1972.

Although somewhat dated, this document supplements the Filep, et al. bibliography.

G5. Harrison, S. A. and L. M. Stolurow, Eds., "Educational Technologies: Productivity in Higher Education," Final Report of Symposium held at Stony Brook, N.Y., supported by National Institute of Education and Office of Education, Setpember, 1973.

Although the word "satellite" appears rarely if at all in here, the symposium proceedings cover a broad spectrum of both technologies and issues. I believe this is scheduled to be issued as a book by Educational Technology Publications.

G6. "Ten Year Forecast for Computers and Communications: Implications for Education." Papers presented at Airlie House Conference, Warrenton, Virginia, sponsored by NSF Education Directorate, September 16-18, 1975.

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*Published by University of Mid-America, P. O. Box 82006, Lincoln, Nebraska 68501.

Again, relatively little satellite emphasis but a lot of information on other developing technologies and their uses at all educational levels. Should be a formal proceedings coming out soon.

G7. Polcyn, K. A., ed., "The Educational and Training Uses of Broadcast Satellites: Status, Applications, Costs and Issues." Educational Technology Press, New York, 197-

Should be a useful volume. As of this writing, it may not have been published.

S1 - S7. Specific Educational Satellite Experiments

The following reports represent documents about specific educational satellite activity. They have been useful in preparing this paper. They are principally reports by individuals and organizations involved in the experiments. Final evaluation reports of the ATS-6 educational experiments sponsored by NIE are also being prepared. These latter reports should be added to the list of important documents when completed.

S1. "The Appalachian Education Satellite Project:

a. Final Report
b. Executive Report"

Prepared by Appalachian Regional Commission upon completion of ATS-6 experiments for the National Institute of Education, Fall, 1975.

S2. "Satellite Technology Demonstration:

a. Final Report
b. Executive Report"

Prepared by Federation of Rocky Mountain States, Inc. upon completion of ATS-6 experiments for the National Institute of Education, September 15, 1975.

S3. "ATS-6 Health/Education Telecommunications Experiment: Alaska Education Experiment Summary.

a. Final Report
b. Executive Summary"

Prepared by Office of Telecommunications, Office of the Governor of the State of Alaska for the National Institute of Education, September 30, 1975.

S4. "ATS-6 Health Experiment: Indian Health Service/ Alaska, WAMI Experiment in Regionalized Medical Education/Seattle Washington"

Phase 1: Planning and Development, December, 1974
Phase 2: Operations, December, 1975.

Prepared by University of Washington (Seattle) Project Office for Lister Hill Center for Biomedical Communications, National Library of Medicine.

S5. "ATS-6 Satellite Evaluation: Final Report of the Communications Satellite Demonstration in the WAMI Decentralized Medical Education Program at the University of Washington." Prepared for Lister Hill National Center for Biomedical Communications, September, 1975.

S6. Caldwell, K. S., "The Veterans Administration Experiments in Health Communications on ATS-6 Final Report: Section V: Data and Evaluation." Applied Communications Research, Stanford, California, 1975.

S7. "Communications Technology Satellite: United States Users Meeting #13" NASA Kennedy Space Center, Florida, January 15, 17, 1976.

V. APPENDIX

Ideas for Satellite Use in Adult and Higher Education From Paper by B.W. Kreitlow in Reference (61).

Ideas for use of ETS-11 coming from Graduate Student Seminar at Northern Illinois University:

1. The Live Eric - Plug researchers into a live seminar response to the major problems confronting selected fields of study. Use the Eric or other data and literature bases to print out related materials prior to and following the live seminar.

2. Replace all "mini" systems (audio visual center, duplicated computers, ETN's, etc.) with a single maxi system (the satellites) that cover the area.

3. Coordinate the extreme specialties where neither research nor teaching facilities should be duplicated at more than a handful of institutions. Then have this limited number carry that special field (with satellite tie in to institutions with a small number of learners. This latter group will get the basics of the specialty before transfer for a final period of study at those institutions with the specialty.

4. In selected fields with master resources, offer special courses across the footprint. Example: a professor lectures, illustrates and demonstrates to ten campuses two days per week. This can be live or taped. Then he conducts live videoplace class discussions with each of the ten as a follow-up. This could be the professor's full teaching load and only "master teachers" would be selected for this.

5. Call the satellite "Footprint University". Centralize primary resources, i.e., library, films, audio-tutorial research exchanges. Concentrate on very special fields such as medical instruction where rare surgical operations are shared, special diagnoses, medical school consultations and all specialized in-service education in this field. The same can be developed in law, business and special areas of education. In-service education will take highest priority over the footprint. "Footprint U" could become the key staff development and in-service unit for the professions in the area. Continuing Education units as used in some professions could be "centrally" "banked" and on print out call.

6. Special vocational training from on site (factory) settings. In very special and fast developing areas it should not be necessary to duplicate facilities in vocational schools. Vocational schools should provide the vocational basics while ETS-11 is used to keep up with the changing hardware that is on the factory floor and is broadcast live to the vocational schools or tapes are available for follow up.

7. Develop a research reporting system that removes lag time. For example, research on new agricultural pest controls, cancer research, adult learning, new outcomes from Day Care Centers, etc. would vie for scheduling on the standard research time slot open each evening from X to Y hours. Each live TV research reporting will be followed by Eric type printouts of background and new materials.

Suggestions for satellite use in adult and higher education coming from the Satellite/Cable Conference at Madison, Wisconsin:

1. To audition and preview courses. Useful for faculty to decide if they want to use a course, and for students to decide if they want to take it.

2. Set up a lecture format with periodic multiple choice questions answered by students through a digital touch pad. The answers would be aggregated by a small computer, and, if the students seemed to be comprehending, the next taped lecture would be shown. If non-comprehension was indicated, a review tape would be shown. Lecture - question - answer - comprehension - lecture - noncomprehension - review - lecture - etc.

3. Mid-west university alumni update project. Use a consortium approach to the need for providing alumni with convenient, low cost "retread" education. Make available a continuing update in their primary professional fields, as well as for others.

4. Set aside the first two months to two years as open time for experimentation without prescribed uses to promote searching by the university, community groups and individuals as yet unable to fill the space.

5. Provide for a history and heritage cultural exchange between older people in various regions. This would involve the campus and the elderly in developing ethnic appreciation.

6. Develop a maintenance oriented society through (1) awareness, (2) information and instruction on maintenance activities, (3) sharing of maintenance ideas, (4) productive use of time for the maintenance of products used to decrease the drain on material and human resources.

7. Involve the public with their elected lawmakers at, perhaps, the state level. Give state audience access to legislators in session, then, on a local level, people would interact among themselves and feed back to their representatives. This could also include information sessions on the state and federal law-making process.

VI. POSTSCRIPT AND ACKNOWLEDGMENTS

This paper was prepared over a very short period of time. Feedback concerning possible omissions or suggestions for improvement would be greatly appreciated. Areas which deserve more investigation than they received in the paper include satellite utilization for delivery of education for the handicapped and teachers of the handicapped. In addition, a review of experiences with satellite utilization in higher education outside of the U.S., particularly Canada, might have yielded additional insights.

In writing this paper, I relied heavily upon planning studies performed previously on satellite applications in education performed at the Center for Development Technology (CDT), Washington University. Several CDT documents provide greatly expanded information and analyses of educational telecommunications services, in case the descriptions in this paper prove to be too concise. In particular, reference [C1] serves as a major compilation of such information.

Other sources of information extensively utilized were the final reports of the ATS-6 experiments. It should be kept in mind however, that mine is essentially a second-or third-hand account of what went on. Potential users of satellite technology with little experience are well advised to get additional information and insights from these reports, evaluation reports being prepared for NIE, as well as directly from previous experimentors themselves. Other sources of potentially useful information to contact are the Public Service Satellite Consortium and the Joint Council on Educational Telecommunications.

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